DOCUMENT RESUME

ED 056 839 RE 003 914

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TITLE The Neurophysiology of Learning and Pedagogy.
PUB DATE Dec 70
NOTE 11p.; Paper presented at the National Reading Conference, St. Petersburg, Fla., Dec. 3-5, 1970

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Aurally Handicapped; *Case Studies; Conference Reports; Hyperactivity; *Learning Disabilities; *Neurologically Handicapped; Perceptual Motor Coordination; *Physiology; Reading Clinics; *Reading Difficulty; Teaching Methods

ABSTRACT

In an effort to narrow the gap between scientific findings and applied clinicians, the author exposed clinical cases to recent laboratory findings of neurophysiology and sought to relate some possible linkage between the two. Two studies about the operation of the mind in information processing and learning were related to two clinical cases. The hyperactive child in the first case was partially brain injured. Visual modes of instruction tended to excite him excessively and result in poorer performance. The author proposed that for this child, audio presentation of instruction would offer more learning prospects than video. In the second case, the child's slight hearing loss was assumed to have resulted in some distortion of auditory input, and this affected his learning. It was felt that the child's facilitation pattern for coding was not sensitive enough for picking out cultural chords and that for him the instructional system might be too encumbered. It was concluded that breaks in learning often stem from physiological processes and that the psycho-educator should make use of the established facts of the past 7 years from anatomy and physiology to update pedagogy. References are included. (AW)

ED056839

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"The Neurophysiology of Learning and Pedagogy"

Excitation and its effects

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The nature of my paper, to expose clinical cases to very recent laboratory findings of neurophysiology and thereby propose some possible linkage between the two, recognizes that the proof line is thin when attempting to connect a new theory to new facts. Both theory and fact need verification. This being kept in mind, the writer will make some proposals to learning theorists and pedagogical ministers. Each case is taken from the files of the Reading Clinic and Guidance Center.

It has been the experience of the writer that the artists of pedagogical systems usually trail the innovations of the clinicians some twenty to thirty years. One supposes that the gap between scientific findings and applied clinicians is in the range of five to ten years. Perhaps the first time lag may be reduced by exposing more clinical cases

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to the findings of neurology and physiology, but first, ~~three~~ two scientific contributions will be cited.

I. P. Pavlov, (5) in his studies on conditioned reflexes gave momentum to the interpretation that the brain serves as transmitter and sifter of specific information with analyzing ability. By this we have come to a better understanding of the prospect of learning through afferent signal reinforcement.

Penfield (7) showed us how the experience or learned information of his wired patient was available for both storage and recall. He showed that an experience(s) can be retrieved in great detail if temporal nuclei are stimulated. So it is possible to get back this message from the brain, pretty much like a printed tape or audio cassette.

With this revelation the colossal ability of the brain to receive and retain vivid details of experiences for retrieval purposes became irrefutable, and the significance of this is still being felt by learning theorists and pedagogists.

For educational psychologists the control of experiences for learning and their sequential representation over afferent channels and their later usefulness take on more significance in learning skills and in learning behavior. Educational systems have followed these scientific contributions, albeit, many years later. Now let us look at two clinical cases.

CASE: RICH Mc

Rich Mc, C.A. 14.4, M.A. 16+, an MBI at birth, hard delivery. In early childhood, ages 5 to 8, he had <u>difficulty</u> in coordinating, in doing copy work, in writing, and with eye-hand activities. He later overcame this handicap. He has received medication for a number of years and is currently taking dilantin. He has good functional vision.

Cl[illegible]el Signs:

1. On the Binet Word Naming he started and perseverated on technical and polysyllable words. He was locked in a slow, mind set. This lowered his word production to the twelve year old level.
2. His verbalization was well-organized, clear, and given in good sentence structure. His abstract thinking was faulted only by his seeking and giving abstract approaches to practical situations, to the point of error.
3. In memory for design tests (visual), his production was correct, but he rotated the cards 15°. His poorer performance in the visual type tests raised the question of what excited or triggered him into rotating the cards. (1) Similarly, something excited him a while later when he received messages from the board or film. He did less well on these visual tests. Psychoanalytically he was as one lost, looking for a clue instead of looking at the cue itself whose visual form was simple enough.
4. Another visual excitation which was in the wrong direction for Rich Mc was his inability to punctuate pre-typed sentences; yet his use of grammar was good.
5. In language usage of printed sentences (visual), such as the following, he chose b as the best sentence instead of a.

    a. I think his coming is unfortunate.
    b. We saw your going to the show.
    c. I heard his playing seated on the piano.

Visual activity of this sort apparently interferes with his reasoning and he does poorly; whereas, in verbalizing he correctly uses the sentences and gives their meanings.

Walter (9) has said the EEG brain rhythm shows that sensory stimulation of the visual field causes blockage of the A rhythm, which characterizes the waking brain, and accelerates the appearance of the faster B waves. Rich Mc is hyperactive; he is partially brain injured; and he is sensitive to light. Could this photic stimulus lead to faster wave action causing dysrhythmical patterning?

Specifically, did verbalizing and abstracting keep him in a constant state of A rhythm and thus free him for better performance afferently at the higher cortical levels?

Did visual presentation of material excite him excessively and to poorer performance, because afferently he got into an excitable stage? And did this stimulus interrupt his normal physiological afferent processes?

Obviously some students are excited by visual modes of instruction and become overblocked. How excitation of the visual receptors leads to ineffective learning or wrong selection is a serious concern of psychology and its extension into pedagogy.

The problem may be even deeper. We might look to biophysiology for answers. For example, records were taken from single neurons with and without stimulation from a flickering light. The reticular activating system was then electrically stimulated and recorded. If a neuron was spontaneously firing, the RAS activation caused an increase in spontaneous firing rate. When the neuron was responding to the flicker, stimulating the RAS considerably increased the number of impulses elicited by the flashes. Such stimulation increased the activity in lateral geniculate nucleus neurons that give rise to the optic radiations leading to the visual cortex. (4)

While it is dangerous to make a connection between the physiology of the above and learning; nevertheless, there is enough indication that the cells operate in a coded manner. An interruption or displacement of such rhythms will therefore bear on the afferent processes, and defective feedback is possible in such instances. There are still two other explanations.

Again taking a tenuous position, there is experimental evidence that rhythms do not originate in the cortex and, furthermore, that rhythms come from subcortical sources, which suggests that they are dependent upon afferent impulses. (2)

There is also implication that desynchronization of the unconditioned analyzer can occur which might subcortically shunt sensory messages at times of learning. (3)

The possible connection to learning of these last two points might be significant and might become vital to pedagogy.

Speculatively, is Rich Mc at the clinical level showing these phenomena? His output in oral language is better than when visually receiving the same material. It is in such cases that pedagogy should pick clues, use the findings of other research, and modify older accepted procedures, and sequences. Systematized learning principles need re-examination. This last suggestion should not escape the college and secondary segments whose cavernous halls now bombard 500 students at one time with audio-visual disonance and consonance, with very little regard for the individual's makeup. In this case audio presentation would offer more learning prospects than video.

CASE: David H

David H; C.A. 13.2, M.A. 14.5, 7th grader, repeated the first grade; 60 decible loss in left ear in the lower and highest frequencies and less in the medial range; the condition was discovered at age 11.8 in the 6th grade.

The subject possesses above average intellect and ordinarily would be expected to achieve quality school performance. It is necessary to detail these clinically obtained educational facts in order to probe for possible physiological connections. David H's scores follow:

Vocabulary Meaning, Multiple Choice	8th grade level
Study Skills	6th grade level
Recall of Silent Reading	4th grade level
Paragraph Meaning	5th grade level
**Sight Word List	6th, 7th - 80%

In Special Testing at the primary level, grades 1-3:

> In Vocabulary Meaning when matching from five words, he missed one word in fifteen at the 2nd and 3rd grades.
>
> In Oral Reading of a 25 word passage, he made four gross word errors at the 3rd grade.
>
> In Sight Words, he missed one in fifteen at the 1st grade, three in sixteen at the 2nd grade, and four in eight at the third grade.

We have here an inkling that this youngster has missed moments of learning stimuli, that these bits of instruction were not effective because they were aurally missed or distorted.

It is not suggested that David's slight hearing loss, as a biological malfunction, is in direct relation to partial loss of instruction. It is suggested that his hearing as part of a physiological

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**Here E suspected basic primary deficiencies and did the special testing at grades 1, 2, 3.

system is not totally sensitive.

In David H, two significant points stand out. A faulty receptor organ has led to an imperfect learning, with vestigial errors of the primary grades being carried into the seventh grade.

> Psychologically this imperfect hearing has resulted in a peculiar response mechanism, which is characterized as follows: He seems to understand and draws correct conclusions, but when asked to explain gets off the track and decides he was wrong. He likes his situation to be rigidly structured. He insists on knowing terms and demands of each task, whether one term or a series of terms. This insistence is his security, but his randomness in response is a by-product of his imperfect hearing.

> The pressure pulses from the ear did not get through and are not getting through properly.

Penfield (6) remarked:"One conclusion is clear: the initially uncommitted cortex of the temporal regions is programmed by the child during early years of life--programmed for speech, or for perception, but not for both . . . while a child is learning, the nerve impulses pass along collateral branches of a neuron and through the junction of that branch with another cell, and facilitates that pathway. In time, the facilitation becomes absolute, and the linkage of the cell is fixed". In David's case the facilitation pattern for coding is not sensitive enough for picking cultural chords.

His eighth grade level score in Word Meaning should mean no errors at the second or third grade levels. Yet errors were found; one error in fifteen at grades two and three. The vocabulary score at the eighth grade level was made on a test in which one word of four was to be selected to match an italicized word in the sentence. The Primary grade level errors in word meanings were made on a test in which the stimulus word at the left was to be matched with one of four words to

its right.

Now by themselves the information might have no implication except to say that clinically this sometimes happens. Here the findings cannot be by chance. This youngster had repeated the first grade and is now in the seventh grade. Biologically we are more correct to say that organically the hearing is partially imperfect which in turn distorts the signal. This distortion of imput carried along the learning pathways has its effect on the quality, the identification and the sequence of the sound. At this stage the learning trace can more specifically trend away from perfection.

In effect, learning is going to be marked with irregularities, gaps and some unexplainable surprises, mainly embarrassing to him.

It is this trending away from perfection which is shown by the thirteen year old bright youngster who does not know when or why he makes the mistakes. He is not sure, since at times he does well and at other times he does not. When he restudies the same assignment, his imperfect primary education background may contribute other flaws in the rereading.

For pedagogy this subject at least reveals that the "system" of instruction may be too encumbered. In the light of conditioning theory will pedagogy look away or incorporate the forty-seven sounds of the Roman adaptation to the English language? As it is now, conditioning to over 2000 word sounds, is necessary with numerable reconditionings to to take care of exceptions and irregularities. One would expect the science of instruction to follow the simpler conditioning for learning and to use the "new" language of sound.

BIO-PHYSIOLOGY AND PEDAGOGY

The trend in learning research in the past decade has gone along a biological front and contributions from this field need to be utilized by our discipline. We need to direct far more attention to these newer interpretations. The biological relationship to other disciplines is increasingly evident.

Perhaps the biology of reading rings too organic; however, reading as thinking would carry the force of functional physiology. We can see this in our cognitive minded reading specialists who are trying to adapt to structure and coding.

NEURAL PHYSIOLOGY OF LEARNING AND PEDAGOGY

Deviates point up a message and a challenge to psychologists and educators. Their difficulties in learning may be rooted in environment, culture or education. This much we know. What we don't know are the skips, the breaks in learning which stem from physiological processes.

Through pharmacology a few things have been attempted like medication which can bring on a change in hyperactivity. Such chemical medication slows the activity of the body, and this helps to increase the attention of the learner.

There is much that deviates are pointing out and we need to search more into the science of physiology. Then, to the extent that psychology utilizes the above findings, especially in relation to learning principles, to that extent we can expect that pedagogy will be sound. To the extent that deviates are used to test these findings, then to that extent will pedagogy lay down proper procedures for learning. As of now

the pedagogist relies on rationale, logic, convenience and to a fair extent on earlier outmoded theories of learning and to some measure on historical methodology. Of course the functioning body is not aware that administrators rely on the above.

A closer tie-in, by the architect of administrative methodology, with the established facts of the past seven years from anatomy and physiology, is called for. The psycho-educator should enter here and update pedagogy.

December, 1970
October 1970

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